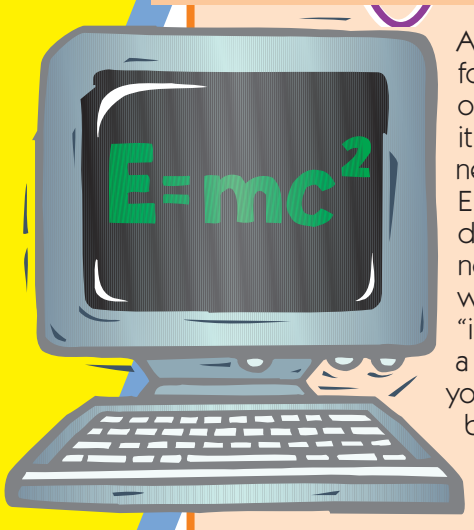
XTREME ENGINEERS

What do Engineers do?



Anybody can come up with a good idea for a faster car, more powerful computer, or taller building, but if you want to make it happen, you are going to need an engineer.

Engineers are the people who turn dreams into reality. Yet many people are not really sure what engineers do. That's why engineering is often though of as the "invisible profession." Yet everyone does a little engineering in his or her life. Have you ever built something out of Legos or blocks? That's a form of engineering, and you probably didn't even know it.

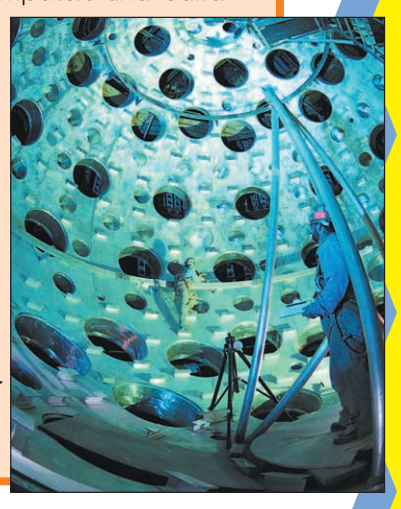
Engineers created the roadways we use to travel across our country, build spaceships to explore outer space, design submersible craft to explore the ocean floor, and even create systems to carry water from the mountains to our kitchen sinks. Just about everything we own needed an engineer to design and build it. Engineers even create the tools we use to build things and the materials we use to build things with.

Engineers use math and science to create something of value from our natural resources. Yet engineering is not really considered science. Most engineers generally don't "do" science. Science is about discovering the natural. Engineering is creating the artificial.

Engineers use creativity and computers

Theodore Von Karman, a famous aerospace engineer responsible for advancements in flight during the post World War II era, put it nicely when he said, "Scientists discover the world that exists; engineers create the world that never was."

Engineers are very creative people. They synthesize, solve problems, and innovate. Engineers are always looking for ways to do things better. To an engineer there is no such thing as the fastest or most powerful. Engineers use a wide variety of tools to do their jobs. They use computers and build models. They draw detailed charts and diagrams to show what they are trying to accomplish. And they test every part of their design to try to prevent anything that can go wrong.



Engineers at the Lawrence Livermore National Laboratory designed the 10-meter diameter target chamber for the laser in the National Ignition Facility (NIF).

So Many Kinds of Engineers

There are lots of different types of engineers. Here are just a few. Can you guess what they do?

Aerospace Engineering
Ceramic/Materials Engineering
Chemical Engineering
Civil Engineering
Electrical/Computer Engineering
Environmental Engineering
Industrial Engineering
Manufacturing Engineering
Mechanical Engineering
Petroleum Engineering

What it takes

No matter what kind of engineer you become, you need to get a college degree. You need to be interested in solving problems and wanting to make things work well. You should be very detail-oriented.

Engineers spend lots of time studying math and science, but they also study things like art and design. Some engineers even need a special license to practice the type of engineering they like.

Engineers also need communication skills. Engineers usually work in teams and have to work with people in science, management, finance, construction and more. Engineers write reports to document their work so others can use it or add to it. The best engineers are not just good in math and science. They are those that have a well-rounded education. The best ones do great engineering with their math and science background, but then convince someone to provide financial support for their project and work with the construction forces to actually build something.

Everyday brings something new to engineers. As long as people can create or question, want to go faster or farther, or make life easier through some new invention, we will need engineers.

Today's Super Scientist

Zafer Demir, Hydrogeological engineer, working at Lawrence Livermore National Laboratory's Environmental Restoration Division; Master's degree in mineral engineering from UC Berkeley on Fulbright Scholarship.

Why Engineering?

"I was always more interested in how natural systems function rather than how manmade objects work. Earth (geo) is a very finite system where natural resources such as water (hydro) and mankind exist in a delicately balanced mutual relationship. Our passion to conquer and control nature has created environmental impacts that threaten our own existence. My profession allows us to understand natural systems and study our impact on the environment, so we can find ways to sustain our existence within the limits of natural systems and engineer ways to restore them.."

My project

"I am working in the Environmental Restoration Division at LLNL where our mission is to protect human health, the environment and beneficial uses of natural resources by conducting cost-effective, science-based, state-of-the-art environmental restoration. I am responsible for providing decision support through numerical modeling. Simulating ground water flow and contaminant transport using computer codes allows us to optimize, and to predict the duration of cleanup at our site."

Xtreme Engineering

You have heard of extreme sports — skateboarding, rollerblading, snowboarding, but have you ever heard of Xtreme Engineering? The engineers at Lawrence Livermore National Laboratory are famous for Xtreme Engineering — that is, developing systems that push technologies to their extremes (from the very small to the very large, and very precise at the same time).

The Engineering Department at Lawrence Livermore has a reputation for doing the impossible, or at least what most people thought was impossible. Engineers work with others at the Laboratory and in the Department of Energy's National Nuclear Security Administration to address national priorities — demanding even smaller parts, faster times, greater power, more complexity, and higher precision. LLNL Engineering has developed the world's smallest biomedical instruments and is now helping to build the National Ignition Facility, the world's largest laser.

Here are just a few examples of Xtrreme Engineering projects being conducted at Lawrence Livermore National Laboratory.

Microscale Systems

The next generation of medical diagnostic instruments will combine electronics with fluids on specially manufactured computer chips. Working with the MD Anderson Cancer Center and UC Berkeley, mechanical engineer Peter Krulevitch estimates that his team is one year away from applying this technology to a hand-held instrument capable of separating and identifying cells. These instruments, about the size of GameBoy cartridge, will help identify viruses, bacteria and toxic chemicals that will help save lives.

Meanwhile, mechanical engineer Robin Miles and her team are building a device to purify and concentrate airborne pathogens for more efficient detection. Their designs use tiny fluid channels (smaller than the width of a human hair) etched in glass with special electrodes for identifying and manipulating biological particles.

Ultra-Precision Tools

Mechanical engineer Debra Krulewich has developed advanced methods for correlating the behavior of a machine to its accuracy of a finished part. With this new method, errors can be predicted, and changes to the machine's subsystems can better match finished part requirements.

Monumental Structures

Structural mechanics engineer Dave McCallen, with Lawrence Livermore seismologists and UC Berkeley engineering faculty, is performing large-scale computer simulations to determine how various mammoth structures will respond during earthquakes in California. His detailed computer modeling already has helped CalTrans fine-tune its $50-million retrofit of the 24-580-980 highway interchange in Oakland.

Now he is studying how long-span arch bridges along California's coast--like the San Francisco Bay Bridge--will respond to earthquakes. His studies will improve structural designs and probably save lives in the "Big One."

Dave McCallen , Lawrence Livermore engineer, is studying the Bay Bridge to see how well it responds during earthquakes

Today's Super Scientist

Sabre Coleman, Environmental engineer, working at Lawrence Livermore National Laboratory's Environmental Restoration Division; master's degree in environmental and water resources engineering from the University of Michigan.

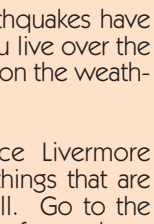
Why Engineering?

"I always liked math and science wanted to choose a field that would be able to use both. Math is a universal language and has so many uses, from cooking and building models to chemistry and engineering. I chose environmental engineering because it's a field that is used to provide clean water and sanitary conditions for the masses. Regardless of culture or continent, people need clean water in order to survive and flourish. "

My project

I am the principal investigator for a research project in which we are using a composite material, made of aerogel and GAC (that's granular activated carbon — the same stuff you use in your aquarium). We will use this to remove contaminants from water.

Super Scientists in History



Theodore von Karman - Famous Aerospace Engineer (1881-1963)

"Scientists discover the world that exists; engineers create the world that never was."
- Theodore von Karman

Dr. Theodore von Karman is considered to be one of the great aeronautical scientists of the 20th century. Von Karman was born in Budapest and spent most of his life as a science teacher in Europe and the United States.

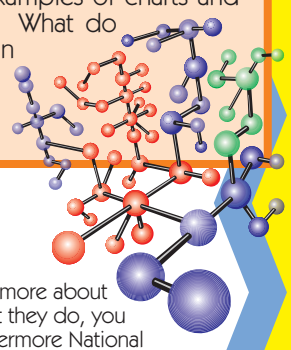
Von Karman's contributions to the scientific community were significant and continue to have impact on modern aircraft testing technologies. He developed many theories of aeronautical and space science, such as the effects of forces and currents on aircraft and spacecraft. He was instrumental in developing supersonic aircraft and Intercontinental Ballistic Missiles, and was involved in the practical side of developmental breakthroughs in aviation.

Activities

1. Engineers work with computer simulations to determine how bridges react to earthquakes. Go to the paper and find the section about weather.
Find out how many minor earthquakes have occurred in the area where you live over the past few days. Find your city on the weather map.

2. Engineers at the Lawrence Livermore National Laboratory work on things that are very big as well as very small. Go to the paper. Can you find pictures of very large things that an engineer could have worked on? Can you find pictures in the paper of very small things engineers may have worked on?

3. Engineers use charts and graphs in their jobs. Can you find examples of charts and graphs in the paper? What do they explain? How can you tell?



Discover Lawrence Livermore National Laboratory

If you would like to learn more about Super Scientists and what they do, you can visit the Lawrence Livermore National Laboratory's Discovery Center, open 1 to 4:00 p.m. Monday through Friday and located in Livermore on Greenville Road. School tours for 4th and 5th grades are available. (Call Linda Lucchetti at (925) 422-5815 for further information.)

For more information about Lawrence Livermore National Laboratory, go to the web at http://www.llnl.gov/